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Science and Art Gossip.

It is commonly said that extremes should be avoided—*medio tutissimus ibis;* but I am disposed to infer that an extreme path is safer than a track which avoids extremes. Quite a number of correspondents ask why I have ventured to express disapproval of the coarse scurrility which characterised the articles in the *Freethinker* which led to the recent action. Quite a number of others ask why I said anything deprecating the action of the law as employed against the three defendants. And those who attack me from either side agree in asking what on earth the case has to do with Knowledge. The best proof that I took a tolerably fair view is afforded by these inconsistent attacks. And as to the way in which this matter affects Knowledge, I take it that a most important sociological question is involved—or, rather, several. As, first: Should there be any laws like that brought into operation on this occasion? secondly, If there are such laws, should they be restricted to those matters to which they really relate, or be applied to punish social offences? and so forth. The malversation of our laws is a matter in which we are all deeply interested, and, as every student of sociology knows, the subject is one which has its distinctly scientific aspect.

Dr. Wainwright says that the statement quoted at p. 156, from the *Manchester Examiner and Times*, is a hoax. We are exceedingly glad to hear it.

The Cambridge crew, the stronger and better trained, has been beaten by a crew rowing a more scientific stroke. The laws of propulsion are better understood at Oxford than at Cambridge.

One is disposed to rejoice that the betting-men were let in—though money lost by some was money won by others. Money won over bets is so near akin to money lost, that the success of non-favourites may be regarded always as a severe lesson for the betting world. To parody a well-known saying, there is nothing much worse for a man than losing money by betting, except winning money.

Mr. Proctor has just brought to a close at Brighton a series of lectures which have afforded him singular pleasure. They were delivered at Brighton College to one of the pleasantest audiences it has ever been his lot to address—an audience including, of course, a large portion of the College boys. An almost unique experience did not diminish the lecturer's appreciation of the kindness of his audience. As usual, in such cases, a certain fee had been agreed upon. It is not *very* unusual for a diminution of the fee to be asked for, when bad weather or some other cause has prevented lectures from being so successful as had been hoped. But it *is very* unusual, when lectures have been more successful than had been hoped, to increase the fee. This, however, was done on this occasion "to the tune" of one-half more than had been agreed upon. Such generosity is worthy of public record.

The Royal Aquarium Company appears to have suffered somewhat through the apathy of the electrical exhibitors and the delay in opening the exhibition. At a meeting of the shareholders on Friday last, the chairman said that they had calculated on a rental of from £1,500 to £2,000, the directors being assured that the exhibitors would take all the available space in the building, and they were also assured that the exhibition could be opened at the time proposed, and that in the four months which it was intended to run the same they would cover the expenses and return over £700 profit. The receipts of the previous day amounted to £200, and at that rate they would soon recoup themselves the outlay.

The exhibition is making very good progress, several new displays having been completed. We doubt the wisdom of showing the semi-incandescent Joel lamps in the same area as several arc lamps. An uninitiated public is apt to draw unfavourable and unjust conclusions. The remark applies also to the Jablochkoff lamps, which do not show to advantage in the neighbourhood of Pilsen and other arc lamps.

Amongst dynamos, the Elphinstone and Vincent, Lumley and Ferranti are all at work, one of the first mentioned being used to supply a 100,000 candle-power search light.

We cannot reasonably expect scientific accuracy in the daily papers regarding chemical compounds, and as the late outrage on Government buildings has given paragraphists much scope for loose and sometimes absurd statements as to dynamite, it may be well to remind our readers that the base of this extremely powerful explosive is nitro-glycerine, sometimes known as nitroleum, which is an amber-like fluid, discovered by Sobrero in 1847. Nitro-glycerine itself is made by adding glycerine, in a manner not necessary here to particularise, to a compound formed of one part of nitric acid and two parts of sulphuric acid. This terrible agent is known as *Glonoin* Oil, and is a light yellow oily liquid, of specific gravity ranging from 1·525 to 1·6. It has a pungent taste, and but one drop placed on the tongue induces intense pain of the spine. Sobrero, when he discovered this fluid, was a student at the famous Pelouze laboratory, Paris. He did nothing to develop his discovery; but Alfred Nobel, a Swede, being in want of a new blasting agent, experimented with the new liquid, known to be highly explosive, and, by adding other ingredients, obtained the now well-known dynamite. This, as usually manufactured, is composed of infusorial earth, porcelain earth, coal-dust, siliceous ashes, &c., and all this base has to be saturated in a certain

proportion with the nitro-glycerine. The process of manufacture is dangerous, and the cost about four times that of gunpowder, while its power is, perhaps, ten times greater. Besides dynamite, other explosive compounds have been made from nitro-glycerine, such as *Dualline*, a combination of wood gunpowder soaked with this terrible oil, while *lithofracteur* consists of fifty-two parts of nitro-glycerine, thirty of silex, twelve of coal-dust, and two of sulphur. Then there are varieties known respectively as colonia powder, lignose, sebastine, heracline, and fulminatine.—P. R.

The amount of light given out by a gas-flame depends upon the temperature to which the particles of solid carbon in the flame are raised, and Dr. Tyndall has shown that of the radiant energy set up in such a flame, only the 1-25th part is luminous; the hot products of combustion carry off at least four times as much energy as is radiated, so that not more than one-hundredth part of the heat evolved in combustion is converted into light.

At a recent meeting of the Académie des Sciences, M. Boussingault showed the members an old bronze chisel found in Peru, of the Incarial period, remarking that he had never been able to produce the hardening to which the old bronze was supposed to be subjected.

The extensions which are now being rapidly carried out at the New-street Railway Station, Birmingham, of the London and North-Western and Midland Railway Companies, will, it is claimed, when complete, render it the largest station in the world. The station will cover more than eleven acres, and the cost of the alterations is estimated at £250,000. The new platform accommodation will be nearly 3,000 ft. in length.

The *Railway Age* publishes a summary of railway construction in the United States for the year 1882. The account covers only the main track, and shows the construction in States and territories. On 342 lines the aggregate is 11,343 miles, or about 2,000 miles more than in 1881, which exceeded any previous year by 2,000 miles. The construction is divided as follows:—Five New England States, 53½ miles; four Middle States, 1,315½ miles; five Middle Western States, 2,077½ miles; eleven Southern States, 1,490½ miles; four in Missouri river belt, 2,063½ miles; five in Kansas belt, 2,157¼ miles; five in Colorado belt, 1,165 miles; six in Pacific belt, 1,020 miles.

The St. Gothard Tunnel has proved a great success, and is causing quite a stir in France and other countries, as may be seen from the fact that a bill providing for the construction of a new direct railway line between Calais and Marseilles has been laid before the French Chamber of Deputies. The promoters recommend their bill to the Chamber on the ground that the opening of the Gothard line has seriously threatened the traffic throughout France with Italy, and that it is urgently necessary that France should take prompt steps to re-establish the claims of Marseilles over those of Genoa as a shipping port. The uneasiness is evinced elsewhere, as, according to the German press, a committee, established at Kempten, has, in conjunction with several Bavarian corporations, urged upon the Austrian Government the construction of the proposed railway from Innsbruck to Imst, on the Bavarian frontier. The extension of the line to Augsburg, *viâ* Partenkirchen, and to Ulm, *viâ* Kempten, is also spoken of. The section from Innsbruck to Imst is about 56 miles long, and is estimated to cost slightly over £1,000,000. It is remarked that this new line and its connections would probably regain for the Austrian lines a good portion of the through traffic for the East, which the opening of the St. Gothard tunnel has lately diverted from them.

A deputation from the Leeds Corporation called the other day at the *Daily Telegraph* offices, Fleet-street, where they spent some hours and saw the practical application of the Fyfe-Main arc lamps in lighting the machine and folding-rooms during the printing of the paper. They were impressed with the suitability and steadiness of the light. Twelve of these lamps, said to be of three thousand actual candle-power, recently sent to Australia, have been selected to light the Houses of Parliament, Sydney, New South Wales.

There is an automatic clock at the Stock Exchange, which has now performed very well for six months, invented by a M. Dardeme. The winding apparatus consists of a small windmill, fixed in a chimney, or any other place where a tolerably constant current of air can be relied upon. By means of a reversed train of multiplying wheels this windmill is continually driving a Hughens's endless chain remontoire—a device well-known to clock-makers. A pawl acting on a wheel prevents the motor from turning the wrong way, and, by a simple arrangement, whenever the weight is wound up right to the top, the motion is checked by a friction brake automatically applied to the anemometer by the raised weight lifting a lever. When the weight is thus raised to the top, the clock has a sufficient store of energy to go for eight days or more, so that it will be seen that it is by no means dependent on a regular current of air. The Belgian Government has for the past two years adopted this system of clocks on the State railways, and we are informed that they are now being tested by certain English railway companies with a view to their adoption.—*Engineer.*

Does the increasing transfer of iron from the interior to the surface of the earth exercise any sensible meteorological influence? Is it in any marked way influential on electric currents, and thence does it affect magnetic storms? This is a question which needs a little thought to answer safely. The development of railways, and the almost universal substitution of iron for wood wherever it is practicable to use that metal, must surely exercise a decided influence of its own. Every year more and more of the iron formerly buried deep in the earth is spread upon its surface, and it is surely reasonable to assume that, electrically at least, some effect is produced; how far we may venture, as some seem now disposed to do, to translate this into a meteorological agency is a problem for science to determine.—P. R.

Mr. Stroh, during a discussion at the last meeting of the Society of Telegraph Engineers, described a highly ingenious experiment with the microphone, from which he deduced that "during the time when the carbons are really in what is called microphonic contact, they are not in contact at all, or, at all events, that there is a repellent action at the point of contact." In the experimental apparatus one small rod of carbon was attached at one end to an almost frictionless oscillating rod, having on its opposite side an extremely light concave reflector. The other end of this carbon rod fell across another carbon rod, which was fixed. The displacement of a spot of light reflected by the mirror showed that the upper carbon was repelled through 1·2000th part of a millimètre.

A NATURALIST'S YEAR.

By Grant Allen.

IX.—CHARR JUMP.

YONDER little spreading circle of concentric wavelets on the still surface of the mere is caused by the flapping struggles of a poor, fallen fly; and the flash that succeeds is clearly due to his sudden engulfment by a leaping charr. Yes, there they are, basking among the smooth pebbles on the clear bottom, for charr love a clean basin to lie upon; and it takes a sharp eye to make out their contour against the indistinguishable mottled grey of their bed, as they lie motionless, without even a fin moving, in the broad sunlight. River trout, which have to pass the best part of their lives heading up against stream, acquire an almost ceaseless trick of gently fanning their fins in rhythmical motion; but charr, which are rather lake fish than river fish, lie perfectly motionless at the bottom, unless they see anything on the surface that induces them to rise placidly from their lazy attitude. They seem, in fact, like the lizards among fish—creatures that love best to bask in the sunshine, and never bestir themselves except for the sake of replenishing the empty larder. Moving about so seldom, they require very little food indeed; for, the less work the body does, the less fuel it requires to supply it with energy; and indeed, when the charr do happen to get a good stock of flies or worms, brought down by the mountain streams that empty into their clear tarns, they do not generally use up the material so afforded them in their own persons, but store it away as fat in their pylorics, thus forming a reserve against the heavy demands made upon them in the breeding season. When the young fry have to be provided for, this fat is expended in producing eggs or milt, as the case may be, the hard or soft roe of our domestic anatomical phraseology. If you catch a charr some time before the breeding season, you will find the pylorics completely enveloped in bags of fat, like the kidneys of a Southdown mutton, while the milt-bags are long and thin; but if (in defiance of law) you catch one during the spawning time you will find the pylorics shrunken and naked, while the milt-bags have swollen enormously, by the transference of fatty matter to them from the provisional reserve.

Charr, as a group, cannot be distinguished from trout by any very well-marked line of division; they form a subgenus of the salmon tribe, noticeable mainly as having a slightly different arrangement of the palatal teeth from that of the true trouts and salmons. The fact is, there is no group of animals in which it is harder to draw lines between the species than in this royal family of fishes. Though an immense number of species have been described, many of which are a good deal different from one another in their extreme forms, it is almost always possible to bridge over the gap by an equally immense number of intermediate types. Besides, most of the species breed readily with one another, and natural hybrids are very common; so that the old-fashioned systematic biologists had hard work to divide them all out into neatly-labelled batches, each consigned to its own particular cut-and-dried pigeon-hole. The evolutionist, however, finds the family much less difficult to deal with. He sees at once that it is a very wide-spread and variable one, descended at no very remote period (as we count geological time) from a single ancestor, and greatly modified by the extraordinary variety of circumstances to which it has been exposed, but still clearly traceable to a single source. Indeed, there is one little peculiarity common to all the salmonoids—the graylings and gwyniads, as well as the trout and charr—which immediately shows the closeness of their subsisting relationship; and that is the fact that the young of almost all the species are barred with bluish stripes, known to fishermen as finger-marks. In this stage, they are all still practically indistinguishable from one another, and are all called alike by the one name of parr.

On the other hand, as the young salmon-kind attain to years of discretion they begin to display their various acquired specific peculiarities. Some of them, like the true salmon and the sea-trout, have taken to invading the salt water; and these have, therefore, developed certain special points of structure which fit them for their migratory mode of life and altered habits of feeding. Others, again, like the common trout, stick to the basins of their native rivers, and vary among themselves in colour or size according to the nature of the bottom or the quality of the food they can obtain. Yet others, like the great lake trout of Scotland, or the namaycush of North America, confining themselves to large sheets of fresh inland waters with little or no current, grow much bigger in size, and acquire other distinctive peculiarities in adaptation to their chosen habitat. Of course, these varieties or species have only been produced by long selection of the best adapted individuals, and they have, doubtless, been largely affected by many minor points in the environment, less obvious than food or climate. For example, the competition of other types, and the nature of the local enemies, such as kingfishers, grebe, or divers, must have a great deal to do in producing the differentiation of the various lake or river salmonoids.

The species-making among the charr and trout, however, has gone a great deal further than that. Wherever a little body of either group got isolated in a single disconnected tarn or sheet of water, away from the main watercourses of the country, it has generally been acted upon by special selective causes, which have at last succeeded in producing a new and distinct type. Thus, among the true trouts, we have in the British Isles alone several of these isolated forms, such as the gillaroo, from the Irish lakes; the Loch Leven trout, confined to one Scotch sheet of water; and the Loch Stennis trout, found only in a single mountain tarn of the Orkneys. Much the same thing has also happened among the charr, for besides the common northern charr, which is found in Scotland, we have three or four local species, each confined to a solitary locality. Even our Scotch northern charr itself, though almost identical with that of Lapland, has three less joints in its backbone, and never grows to the same size, thus showing the first steps towards the production of a different species. But in Loch Killin there lives another peculiar charr, much more distinct, and not migratory; while in the Llanberis lakes we get yet another kind, the torgoch; and in Windermere we meet only with a restricted local form, known as Willughby's charr. Again, Dr. Günther, of the British Museum, who is the great authority on the salmon-kind, has shown that the Irish charr, long separated from all the rest of their kindred elsewhere, form a distinct little group by themselves, with teeth much more feebly developed than in other charr; and this, which is probably a mark of an early form, may be accounted for by the fact that Ireland was comparatively early separated from Great Britain and the continent after the glacial epoch, so that no recent improvements in charr economy can ever have been imported thither. Furthermore, even these local Irish charr themselves have split up into at least two distinct forms, one of which, known as the fresh-water herring, haunts the bottom of Lough Melvin only, while the other is entirely confined to Lough Eske and Lough Dan. Equally confusing types are found on the

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continent, especially in Alpine pools, and others are known from the great network of lakes and ponds which threads its way throughout the Northern States and Canada. The secret of these oddly local species is to be found in the fact that an isolated lake stands to fresh-water creatures in much the same relation as an oceanic island stands to terrestrial animals or plants, and it is well known that, under such circumstances, variation is rapid and universal. Indeed, almost all oceanic islands are peopled by a fauna and flora of their own, more or less like those of the neighbouring continents, but altered in adaptation to the special insular needs. It is just the same with isolated pools or tarns; on the one hand, the conditions of life are there more fixed and restricted, and on the other hand inter-breeding with the parent species is practically impossible.

LEARNING LANGUAGES.

By Richard A. Proctor.

(*Continued from p.* 146.)

THE following passage is taken from the "Adventures of Telemachus" in the Hamiltonian series, the translation of which is absolutely literal, whereas, in the cases formerly dealt with, the order of the original was slightly altered, though I think my own absolutely literal rendering showed that to be unnecessary. In passing, I note that the instructions given for pronunciation in the first book of the "Adventures" are not quite correct, the words *Ulisse*, *elle*, *malheureuse*, *immortelle*, *grotte*, and so forth, are given as though the final "e" were sounded, which is not the case except in poetry, and then not systematically.

Pour mieux supporter l'ennui de la captivité
For better to support the weariness of the captivity,*
et de la solitude, je cherchai des livres; car
and of the solitude, I sought of the [*some*] *books; for*
j'étais accablé de tristesse, faute de quelque instruc-
I was overwhelmed of sadness, fault of some informa-
tion qui pût nourrir mon esprit et le
tion† *which might-be-able to nourish my mind and him*
soutenir.‡ Heureux,§ disais-je, ceux qui se
to sustain. Happy, said I, those who themselves
dégoûtent des plaisirs violents, et qui savent
disgust‖ *of the pleasures violent, and who know* [*how*]
se contenter des douceurs d'une vie inno-
themselves to-content of the sweets of a life inno-
cente! Heureux ceux qui se divertissent en
cent! Happy those who themselves divert in
s'instruisant et que se plaisent à
themselves instructing, and who themselves please to [*in*]
cultiver leur esprit par les sciences! En quelque
to-cultivate their mind by the sciences! In whatever
endroit que la fortune ennemie les jette ils
spot that the fortune hostile them [*may*] *cast they*
portent toujours avec eux de quoi s'entretenir;
carry always with them of what themselves to-entertain;
et l'ennui, qui dévore les autres hommes au
and the weariness, which devours the other men to-the
milieu même des délices, est inconnu à ceux qui
midst even of-the delights, is unknown to those who
savent s'occuper par quelque lecture.
know-how themselves to-occupy by some reading.
Heureux ceux qui aiment à lire, et qui ne sont
Happy those who love to read, and who ¶ *are*
point, comme moi, privés de la lecture.
not, like me, deprived of the reading.

This passage should be carefully compared with a free rendering such as the following:—

To bear better the weariness of captivity and solitude, I sought for some books, for I was oppressed with sadness for want of some study which might nourish and sustain my mind. Lucky, said I, are those who lose their taste for "violent delights," and who know how to be content with the sweets of an innocent life! Lucky are those who find amusement in teaching themselves, and who take pleasure in cultivating their minds by science! In whatever spot hostile fortune may cast them, they bear always with them the means of entertainment; and weariness which oppresses other men, even amid delights, is unknown to those who know how to occupy themselves in some course of reading. Lucky are those who love reading, and who are not, like me, without matter to read.

* *Ennui* in the translation; but though *ennui* has become anglicised, it is not English.

† *Instruction* in the translation; but *instruction* in French is not the equivalent of *instruction* in English, which in French would be *enseignement*.

‡ I have altered the translation here; *pût* is simply translated *might*, which is insufficient.

§ *Heureux* is best translated *lucky*, as a rule.

‖ *Disgust* is rather too strong a rendering of the French *degoûter* in the reflective form. *Se degoûter de quelque chose* means simply to "*get rid of the taste for*" something or other.

¶ It is not possible to render literally *ne-pas* and *ne-point*. The words *pas* and *point* were not originally as they now are, negative of themselves, so that *ne pas* and *ne point* were not originally double negatives. It should be noticed that, in writing, *ne-point* is a more emphatic negative than *ne-pas*.

TRICYCLES IN 1883.

By John Browning,

Chairman and Treasurer of the London Tricycle Club.

ALTHOUGH the prevailing fashion in tricycles is for front-steerers, yet some novel machines of great excellence, which have been brought forward this year, are rear-steerers.

It should be carefully noted that in these new machines the faults which have brought rear-steerers into disfavour have been rectified, while their good qualities have been retained.

We are indebted to Rucker for showing us how to make the rear-stearer a safe machine. He first did this by bringing the cranks nearer to the rider than the axles of the driving-wheels, so that his weight was further back in the machine and more on the steering-wheel. By this means, as the rider was more over his work, he gave him more vertical action, which is invaluable for hill climbing. At the same time Rucker introduced double-steering by adding a second rack-rod; both rods were brought into play by using either hand; back-lash is avoided and the steering is rendered very steady and certain.

I have heard Mr. Rucker say that he can rush down a steep hill with his arms folded on one of these machines. Used with the smallest amount of discretion I regard these machines as perfectly safe, and no machine is safe used otherwise. Paradoxical as it may seem, I think there will probably be less serious accidents in the long-run with rear-steering tricycles than with front-steerers.

Riders of rear-steering machines know that it is best

not to run down steep hills at a greater speed than from ten to twelve miles an hour, while those who ride front-steerers consider it safe to rush down hills at any pace. I can assert, both from my own experience and that of my friends, that it is not so.

One reason why rear-steering machines have fallen back in public favour has been that they were none of them double-drivers from one chain-gearing. Of course, a main axle running right across the machine is inadmissible. This year Rucker has introduced two rear-steerers with double-driving balance gearings of good promise, which are attached entirely to the cranks.

One of the most original tricycles brought forward this year is the "Quadrant," by Lloyd Brothers. This machine is a rear-steerer, with the steering-wheel nearly as large as the driving-wheels. The three wheels are arranged with their axles nearly in the form of an equilateral triangle, and the rider sits about the centre of the triangle. His weight in this position not being directly over either of the wheels, he experiences the minimum of vibration when travelling over a rough road. The large steering-wheel will pass over a brick with less jar to the rider than he would experience if the small wheel of a front-steering machine came in contact with a stone one or two inches in diameter. A small steering-wheel often skids, and so makes the steering uncertain, and this skidding frequently drags the tire off the wheel.

It is a great pleasure to note the numerous thoughtful contrivances in this machine. The machine is a perfect double-driver by means of a patent clutch. It has a double-band brake, acting simultaneously on both driving-wheels. This brake is so arranged that it can be kept on at full power with the pressure of a single finger. Foot-rests are provided, but the feet may remain stationary on the pedals at pleasure. This leads to a great saving of power, as riders often keep on driving down hill when the machine would run alone quicker than they are driving it. They simply cannot move their feet as fast as the pedals will run.

The saddle is adjustable in every direction. The handles are also adjustable. No spanner is required to clamp these parts when they are adjusted, and the weight of any rider would not shift them once they are set. I expect to hear a good deal more of this excellent machine, as it is a most valuable addition to our list of trustworthy rear-steerers.

I would venture to suggest to the makers that they would do well to make their small machine, which has 40-in. driving-wheels, lighter, when ordered by light riders, and gear the wheels up if speed is required. Such a machine need not necessarily weigh more than 80 lb.

Some of my tricycling friends have asked me why I devote so much space to rear-steering machines? I reply, because I believe that they are right in principle, and it is only in details they have been wrong. A very thoughtful rider, to whom I made a similar remark a few days since, replied, "Certainly; if not, we ought to take all our horses out of our vehicles and harness them with their heads in the shafts so that they should push the vehicles along instead of pulling them."

The rider of a front-steering tricycle pushes the greater portion of his machine along before him. The rider of a rear-steerer pulls the greater portion of his machine along behind him. On a rough road, just where a rider wants all his power, the front-steerer, then, is at a great disadvantage, as the small steering-wheel is pushed against every obstacle, instead of being pulled over it, at the same time, a much greater amount of vibration is communicated to the rider. Front-steering machines should have the steering-wheel about a foot more in advance of the machine than they are made at present; they resemble a boat with the rudder in the bow, and as now made in short turns on a rough road they do not answer their helm properly.

Many subscribers to KNOWLEDGE have written me privately, asking me to tell them which is the best tricycle. I regret that it is impossible for me to give them this information. There is at present no such machine. I can tell them which is the fastest machine, which is the safest machine, which is a good hill-climber, which is the best for a rough road; but they will not find all these good qualities combined in any one machine, nor will the same machine suit a very heavy man and a very light one, even for the same roads. In my articles on tricycles I have tried to indicate the strong points of each machine, and I am sure, if my readers will look over them again, bearing in mind what I have just said, they will be able to select the machine best suited to their own special requirements.

PRAYER AND WEATHER.

BY RICHARD A. PROCTOR.

A CORRESPONDENT submitted to me a paragraph relating to prayers for better weather. He asked the purely scientific question whether I supposed the weather would be affected by such prayers. To this I replied. Quite a number of correspondents have objected, apparently labouring under the truly absurd delusion that the question is a religious one. They ought to see that meteorology is a scientific subject, though, as the Director of our Meteorological Observatory points out in his recently-issued work, it has scarcely yet developed into a science. If science understood meteorology as well as it understands the movements of the heavenly bodies, it could have told the President of the Wesleyan Conference whether the weather he wanted was due or the reverse, and *why*; so that, supposing, in accordance with natural laws it would continue without the desired change, he might either have seen the propriety of ceasing to pray, or, if he went on, have known precisely where the order of nature would require to be interrupted in order to produce the desired change.

But for this ignorance prayer for a change of weather would be seen to be much like prayer for or against an eclipse. The savage who sees the sun apparently encroached upon, or—as he thinks—devoured, prays lustily that the destruction of the great luminary may be prevented. He would doubtless regard an astronomer who should tell him that the sun would disappear in a little while, let him pray his hardest, as a very wicked person. One who was not quite so well informed as the astronomer, but not quite so ignorant as the savage, might not know how near the eclipse would be to totality, yet would see the absurdity of praying for what he knew to be a natural phenomenon. He would reason that, if the eclipse was not going to be total, prayer that it might not be so was unnecessary; and if it was going to be total, such prayer must be useless, unless a miracle was to be performed in response to it. The meteorologist of to-day is in somewhat the position of our supposed middle-man—he knows the progress of a bad season is a natural phenomenon, and that to pray for any change, however desirable the change may be, is to pray for what is either bound to happen (soon enough to be of use) or bound not to happen, unless a miracle is prayed for.

But then, say some, the weather may be changed in response to prayer, not by controlment of the laws of nature, but by means of them. Let them try to think

what they really mean by this, and they will see what it amounts to. What sort of law do they understand by a law of nature? Do they suppose that somewhere or other in the chain of causation on which weather and weather changes depend there is a place where the laws of nature do not operate in a definite way, but might act in one or other of several different ways? This would correspond to the belief of the savage, that an eclipse of the sun is not caused by the operation of definite natural laws.

In point of fact, speaking from the scientific point of view, prayer that coming weather may be such and such is akin to prayer that an unopened letter may contain good news. So regarded, it is proper enough. But prayer proceeding on the assumption that in the natural order of things bad weather would continue, and that in response to prayer it will be changed, is improper and wrong for all who consider and understand what it implies. But then so few do.

What real difference is there between praying that weather may change and praying that a planet or comet (as men in old times did pray, being ignorant) may take a specified course—except that we have not yet mastered the laws according to which weather varies, while we have mastered those which govern the movement of the heavenly bodies.

But again I say the question is not in any sense a religious one. Prayer has no more intimate association with religion than an M-B waistcoat has. It is, and has long been a customary part of the *garb* of religion; but it may equally be the garb of irreligion; and there may be true religion without prayer, even prayer of the kind which is proper and right. I do not wish to depart from my rule to let no question of dogmatic religion be discussed here—no question relating to the specific views of any sect, large or small, influential or the reverse—otherwise I might be disposed to quote the sayings of one of the wisest teachers the human race has yet known. He left a model of prayer containing throughout but one reference to material benefit, and that one not so much appealing for help as expressing contentment with the least possible provision for the passing day. We might also note that the same pure teacher, on the only occasion when he prayed for himself, used words implying submission rather than appeal; in fact, the words can logically only mean simple and entire submission, since it could be preposterous to suppose a change of God's will was prayed for.

The possible influence of prayer in modifying the progress of events is a purely scientific question. On the other hand, the propriety of the prayerful attitude, which really expresses only desire, coupled with submission, is a religious question,—on which (though it is quite outside dogmatic theology, and well within our sphere, which, of course, includes natural religion) I have not touched at all.

As a scientific question, the matter has been debated over and over again—with no particular result, because the student of science can only have one opinion on the subject, while the unscientific only *think* they think about it. Good old Benjamin Franklin was one of the first to be denounced for giving the only possible opinion. But many must have been still more foolish then than several now; for they positively asked him whether he did not think it sinful to devise methods for changing the predestined course of God's lightning!

An Exhibition of Hygienic Dress and Decoration will be opened early in June, under the auspices of the National Health Society, at Humphrey's Hall Knightsbridge, W.

"OUR BODIES:"

SHORT PAPERS ON PHYSIOLOGY.

By Dr. Andrew Wilson, F.R.S.E., &c.

No. VIII.—HOW THE BODY'S DUTIES ARE PERFORMED.

IN our last paper we saw that the body was a complex machine, within which continual actions were being executed and performed. Life, in one sense, is merely the sum total of these actions. Our existence is the result of their exact and continuous performance. It remains, however, that we should look a little more closely at these bodily processes. We must endeavour to ascertain how they are performed, and in what fashion they relate themselves to our daily life.

The word "secretion" is one in constant use in the mouths of physiologists. They speak of the liver "secreting" bile, of the salivary glands "secreting" saliva, or the "water" of the mouth, and of the stomach "secreting" gastric juice. What is meant, then, by this word "secretion"? and what is the use or purport of the function which bears its name? To answer these queries we must reflect a little upon the demands which life makes upon the body's belongings. In the digestion of food, for example, a considerable number of fluids are poured at intervals upon the food. The digestive system, it will be remembered, is merely a tube, opening into which we find certain organs, such as salivary glands, liver, sweetbread, &c. Now, digestion is largely a chemical process. Certain food-elements are broken down, combined with other elements, and made to assume new forms, in which they can be readily combined with the blood. Hence upon the food there are poured the fluids already mentioned, which alter and change the food-constituents as nature directs. Take, as an example, the food-changes which occur in the mouth. Saliva—the "water" of the mouth—is poured upon the food at this stage of digestion. This fluid is furnished by three pairs of organs called *salivary glands*, each gland opening into the mouth by a "duct" or tube of its own. When saliva comes in contact with any starchy foods, the latter are transformed by the chemical action of this fluid into dextrin and grape-sugar. When saliva is analysed, it is found to consist of water, certain minerals, and a substance (found nowhere in the body save in this fluid) called *ptyalin*. It is this latter substance which appears to be instrumental in changing starch into dextrin and grape-sugar—in which latter forms starch, itself indigestible, becomes more readily absorbed into the blood. Hence this substance, *ptyalin*, is said to be one of the digestive "ferments"—a name applied to certain bodies which are found chiefly in the digestive fluids, and which produce chemical changes in the foods submitted to their action.

In the stomach, another "ferment," *pepsin*, exists in the "gastric juice." This latter fluid is "secreted" by the little glands that exist in the substance of the stomach itself. This ferment has the power of changing nitrogenous foods or "albuminoids" into substances called *peptones*. In a word, in the latter form these foods are diffusible, and readily pass into the blood. The liver, as every one knows, is a manufactory of *bile*, which is, perhaps, the most complex fluid in the body. Bile is of a greenish-yellow colour, and when analysed is found to consist of water and solids, amongst the latter being *bilin*, fat, *cholesterin*, &c. There seems little doubt that bile when added to the food (as it is added after the food has left the stomach) acts specially on the fatty parts of the food, whilst discharging other functions. The *pancreas* or "sweetbread" throws *pancreatic juice* on the

food, when bile from the liver is also poured upon it. In the sweetbread's secretion we find water, minerals, and a substance called *pancreatin*. Starch is certainly acted upon by this substance, and such starchy foods as may have escaped digestion in the mouth, are changed into dextrin and grape sugar after leaving the stomach. The sweetbread's "juice" also assists in the digestion of fats, and must in this way aid bile in its work; whilst it is also believed to possess some action upon the albuminous parts of the food, an effect accessory to that produced by the gastric juice of the stomach.

When the food is passing along the tube which succeeds the stomach, and which is called the *intestine* (or bowel), it is thus mixed with bile and pancreatic juice. These fluids are poured upon the food in the first part of the intestine. In total length, the intestine in man measures 26 ft.; the *small* intestine making up 20 ft. of this length, and the large intestine about 6 ft. As the food travels along the small intestine, it has also poured upon it the fluids furnished by the glands of the bowel. The glands are of various kinds, and some at least appear to exercise a digestive action on the food.

To sum up our notes on digestion, then, we discover that the food is attacked, so to speak, at various stages of its progress along the digestive tube by the fluids or "secretions" that are poured upon it; that, secondly, these secretions exert each a chemical action on the food; thirdly, that their effect is to convert the food into a milk-like fluid (called *chyle*) which contains the concentrated nourishment of the food, and which will be added in due course to the blood; and, lastly, that the fluids which thus accomplish digestion are provided each by an organ or organs called, generally, *glands*. That which remains for us is to inquire, how or by what means the *glands* produce and manufacture the secretions of which we have just spoken.

In a manufactory there are three chief elements which demand consideration at the hands of the economist. The first is the raw material, the second is the workman or workmen, and the third is the manufactured article. Each "gland" in a human body is a manufactory which turns out a manufactured article (bile, gastric juice, saliva, &c.) from raw material. The raw material in the physiological factories is *blood*. Here, however, we come face to face with a very deep physiological problem. From one and the same raw material—blood—which is supplied to the "glands," each factory produces a special product, differing widely from that of other "glands." Bile and pancreatic juice, the "tears" of the eyes, the mucous secretion of the nose, and the saliva, are widely different glands; yet they are manufactured from the same raw material. But what of the workmen which perform the work? Here we come face to face with the microscopic elements of our bodies known as *cells*. In our last paper I spoke of *protoplasm*, the "physical basis of life," as seen in the *Amœba*, or "Proteus-animalcule." Now the cells of our bodies, when in an active, living state, consist of protoplasm. The liver is, practically, an agglomeration of *hepatic cells*, each about the $\frac{1}{1000}$th of an inch in diameter. It is "cells" of other kinds that make up the essential parts of the salivary glands; it is "cells" that compose the secreting part of the sweetbread; it is "cells" that make the gastric juice in the glands of the stomach. If, as is certainly the case, the cell is a mass of living "protoplasm," then it is clear that we have at last tracked the problem of secretion as far as we may. Supply a liver cell with blood, and it makes bile; supply a cell of the stomach's glands with blood, and it makes or "secretes" gastric juice. The "properties of protoplasm" is a phrase that means much or little, according as we are wise or heedless of life's acts and wonders. He who is heedless will be apt to say there is no mystery after all; he will urge that living protoplasm, because it lives, discharges these functions, and that there is an end of the matter. But he who is wise will not rest here. He will seek to know *why* one bit of protoplasm makes bile, and *why* another makes saliva. He will regard with wonder the fact that all forms of protoplasm appear essentially similar to all scientific tests. He will look below the surface, and see in the adaptations of this one substance to many and varied ends, another proof of the great contention of modern science—that, after all, the evolution of life's ways and works is as discernible in a study of "secretion," and "cells," as in the growth of the complex animal from the simple egg, or of the flower and its variety from the primitive germ that precedes fruition.

SAND-DUNES.

THE subject of sand-dunes having been referred to in a recent number of KNOWLEDGE, the following facts relating to them may prove of interest:—

Sand-dunes travel in the direction of the prevalent wind. They continue to advance inland and overwhelm everything on their march, even streams failing to arrest their progress.

The mouth of the river Adour, on the west coast of France, has been shifted two and a half miles from its original position by encroaching sand-dunes.

Along the French coast, where they extend for miles, they average from 50 ft. to 60 ft. in height, while on the coast of Holland they have been met with as high as 260 ft.

On the shores of the Bay of Biscay they travel inland at a rate of about 16 ft. in a year, while in some parts of Denmark the rate of encroachment reaches 24 ft. in the same time.

The advance of these dunes has been very much checked within the last few years by their having been planted with the cluster-pine, sand marram (*Arundo arenaria*), etc. These plants bind the sand and form a covering and a net-work of rootlets.

Before these precautions were taken, houses, fields, and even whole parishes were buried beneath the sand.

Occasionally these planted dunes become covered, the vegetation then decomposes and forms a layer of peaty matter.

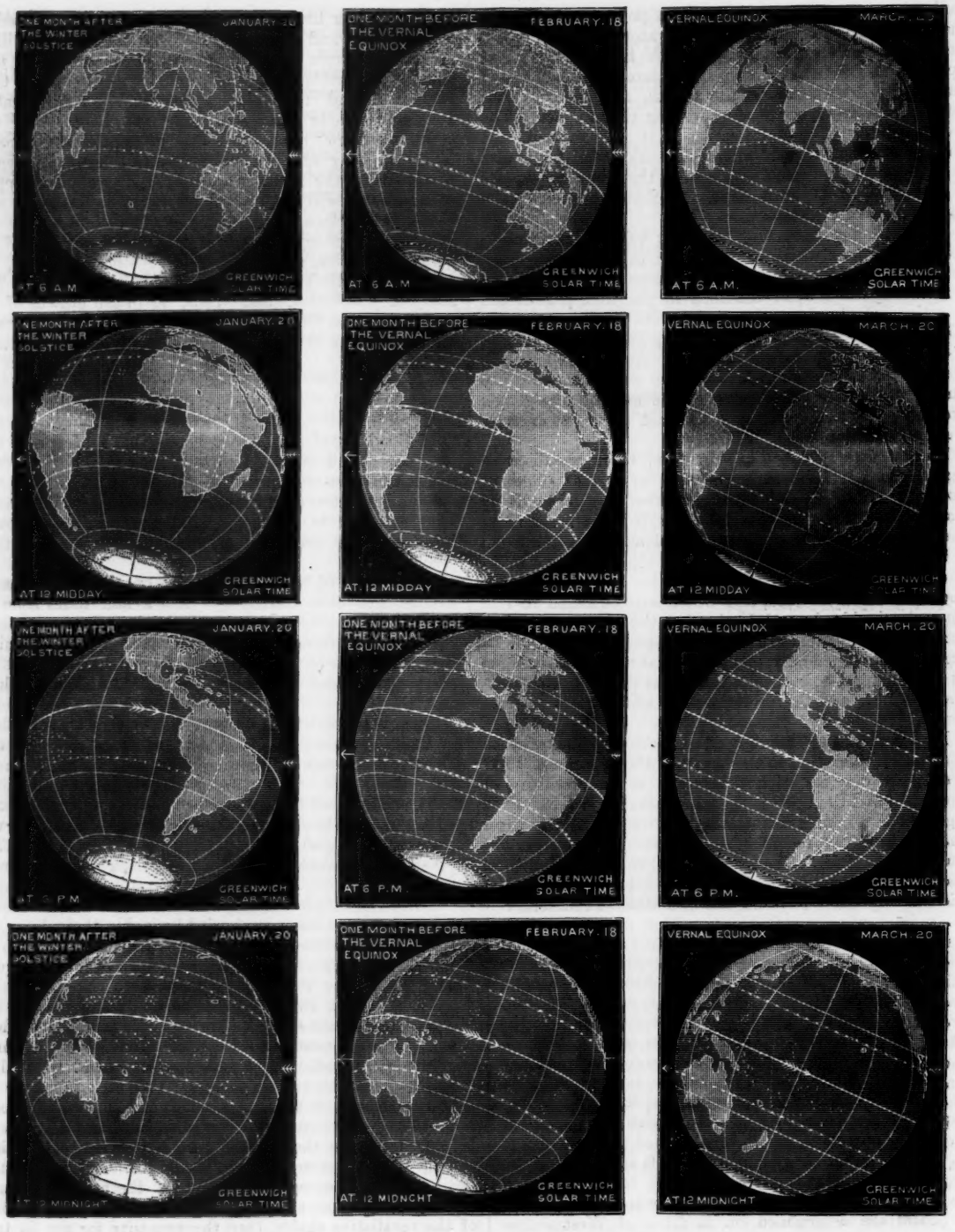
In Cornwall, the West Indies, and other places where the sand is calcareous, or formed of comminuted shells, etc., it is compacted into a hard stone by the action of rain-water percolating, dissolving the carbonate of lime, and re-arranging it as a cement; this rock is common in the Bahamas and Bermudas, where it weathers into caves and picturesque crags.

In Cornwall the hardest granite may be seen polished and worn into furrows where blown sand has come in contact with it, and I believe the Egyptian monuments exposed to the sand drifting from the Libyan desert present a similar polished appearance. Advantage is taken of the polishing or wearing property of blown sand, as in the case of the artificial sand-blast used for engraving glass, or cleaning files, &c.

Has "Philalethes" heard of the "musical" sands? There are some on the coast of Skye; as one walks over them they give out a musical note, probably due to the sand-grains being of equal size.

C. CARUS WILSON, F.G.S.

XUM



SUN VIEWS OF THE EARTH;

OR, "THE SEASONS ILLUSTRATED."

By Richard A. Proctor.

WE give, for this month, the Sun Views, showing the earth's axial pose *towards* the sun, at equal intervals throughout the day, a month after the Winter Solstice, a month before the Vernal Equinox, *and*, as at this present time (as nearly as possible), at the Vernal Equinox. We add two pictures of the British Isles, France, &c., as seen from the sun at the Winter Solstice Fig. 1, and at the Vernal Equinox, Fig. 2 (see opposite page).

THE THAMES EMBANKMENT.

THE intense feeling which has resulted from the vandalism of the directors of the Metropolitan District Railway is fully warranted, for never in recent times has there been so wanton or so unnecessary a spoliation of a people's pride. At the same time it is matter for remark that a body of upwards of six hundred gentlemen could allow the Bill authorising the work to pass through all the formalities without their perceiving its purport. Surely it should be somebody's business to examine every Bill in its passage through the House. If not, the sooner such a defect is remedied the better will it be for the House as well as the country; for if a similar oversight were again to occur, the anger of the people would—and justly so—be turned against its representatives as much as against those who take advantage of its somnolence.

Any one who travels with any degree of frequency upon the Underground Railway, cannot fail to have been im-

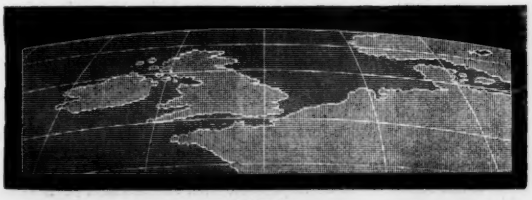


Fig. 1.

Fig. 2.

pressed with the noxious atmosphere, and regular travellers would hail gladly almost any means by which an improvement might be effected. We doubt very much, however, whether the majority of them would not dispense with the railway altogether rather than sanction the construction of a series of ventilating shafts in the gardens of what they are pleased to call the finest promenade in Europe, more especially so when they bear in mind that the company has already sold a considerable amount of ventilating openings for building purposes, and now presumes to make use of the public grounds free of expense. It is not, however, on the embankment alone that the hideous brick, iron, and slate structures hemming in the cuttings are to be erected, but others are determined on in front of Westminster Abbey and in Queen Victoria-street.

Curiously enough, the greater part of the shafts are to be situated between Charing-cross and Mansion House Stations, a portion of the line which is far from being the worst so far as injurious gases are concerned. The *Engineer*, in a lengthy and intelligent article on the subject, points out that: "What the company wants to get rid of is steam, with which the tunnel—especially between the Temple and the Mansion House—becomes so charged that it is impossible for the drivers to see the signals until they are within a couple of yards of them. We state this as the result of observations personally made, not from the carriages, but from the foot-plate of an engine. There ought to be no steam in the tunnel of the Metropolitan Railway, and there would be none if the Company provided proper means of condensing the exhaust steam of the engines. For this purpose, nothing more is required than a sufficient supply of cold water in the engine-tanks. The drivers fill their tanks with cold water at the City terminus, and they have to run with this supply to Earl's-court and other places and back again. The result is that while the engines going out of the City give off no steam in the tunnel between the Temple and the Mansion House, the engines of the up trains, as we may term them, carry boiling water in their tanks, which is, of course, incapable of condensing steam, and the effect is that, although the condensing exhaust valves are kept open, the steam simply passes through the tanks, and escapes through the pipes on top of them provided for the purpose."

What is mainly requisite, then, is more satisfactory condensing apparatus, but what is also to be condemned is the unsuitable plant adopted by the company. Our contemporary, in speaking on this point, quotes a few figures, from which we gather the consumption of coal in a District engine, is nearly cent. per cent. higher than in one of Mr. Stroudley's "terriers" in use on the South London line. "On the District line the trains consist of eight coaches, weighing about 70 tons, and a 43-ton engine, total 113 tons. The Great Western Railway Company runs trains over the District line, the engine weighing 33 tons, and the eight coaches 50 tons, total 83 tons. Mr. Stroudley's engines run nine coaches weighing 60 tons, the total weight being 85 tons. The Metropolitan trains full seat about 350 passengers, the Great Western trains about 280, and Mr. Stroudley's about 400." These statistics demonstrate very clearly that by far the greater part of the present troubles are of the company's own making, and might be avoided by the adoption of more suitable plant.

Even granting, however, that the generation of sulphurous acid (which, by the way, almost invariably proves exceptionally unpleasant between Charing-cross and St. James's-park stations) and other gases is unavoidable, their removal is not by any means an insurmountable difficulty. One pound of quicklime suffices to deal with the products of combustion of one pound of coke, while to change the air completely in the longest tunnel on the line (a distance of 221 yards), "at such a rate that it would be practically pure enough for all purposes, a velocity of a little over one mile an hour would suffice, and this would demand less than one-horse power actual work done."

Our estimable contemporary anticipates that what it has said will be disputed by the company, but "anything may be expected from the persons who can seriously propose to hide the ventilators on the Thames Embankment with trellis-work, festooned with ivy! If the atmosphere of the tunnel is so pure that ivy would grow round the mouths of the ventilating shafts, then the necessity for the shafts would not exist." At the present moment the men are working their hardest to get the work finished, and it behoves everyone to leave no stone unturned until the abomination is prevented or removed. Doubtless some compensation will have to be given—possibly that is what is being hoped for—but we must all pay for experience, more or less dearly. We may depend upon it the lesson will be learned never to be forgotten.

XUM

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO, DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

All Remittances, Cheques, and Post Office Orders should be made payable to MESSRS. WYMAN & SONS.

The Editor is not responsible for the opinions of correspondents.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

COMETS' TAILS.

[763]—With respect to Mr. A. J. Mott's suggestion in the last number of KNOWLEDGE, I would remark that the mean velocity of evaporated molecules must evidently be greater than the mean velocity of the molecules of the occluded gas before evaporation, for the swiftest-moving molecules of the occluded gas will be the first to free themselves from the attractive forces of the molecules near to the surface of the solid body in which the gas is occluded. Thus a selective action will be set up which will cause the mean velocity of the molecules of the gas left behind to be less than the mean velocity of the molecules which escape. In other words, evaporation tends to cool the body from which evaporation takes place.

Thus the mean velocity of the molecular bombardment I referred to will evidently be much greater than the mean velocity of the molecules of the evaporating gas when reduced to the temperature of the solid body from which the evaporation is taking place. For comets near the sun the velocity of bombardment may be quite sufficient to carry such molecules as are not projected into the sun outside the action of the solar system; but the fiercest evaporation will evidently take place towards the sun, and even if the individual stones of a meteoric swarm all revolve rapidly about their own axes, we should not expect a large proportion of the evaporation to take place in the direction in which comets' tails form—that is, away from the sun.

But there are other reasons for believing that the tails of comets are not merely gaseous appendages. When we consider that the orbit of a comet is not sensibly affected by the matter driven off from the nucleus to form the tail during the perihelion passage, we may safely assert that the weight of the tail cannot be great compared with the weight of the nucleus, and that, consequently, the immense space occupied by the tail (or, rather, by the many successive tails driven off during the perihelion passage) cannot be filled with gas sufficiently dense to disperse the amount of light observed. A comparatively dense gas when freed in the laboratory from the minute particles floating in it, appears almost absolutely black when a beam of electric light is passed through it; but the moment that dust-laden air is admitted, light is dispersed in every direction, and the dispersed light is polarised in a manner which corresponds with the polarisation of the light derived from the tails of comets. That is, the intensity of polarisation increases as the angle between the direction of illumination, and the line drawn from the observer to the illuminated particle increases towards a right angle.

A. COWPER RANYARD.

TRICYCLES.

[764]—In reply to your correspondent, D. M., I would beg to point out that I have not in any way fallen into "the common confusion of engine cranks with tricycle cranks."

Three years since, I drew the attention of several of my friends to the fact that I could start any tricycle provided with cranks from the position known as *dead centres* on a fairly level road in good condition; but I should call the moving a tricycle forward under such conditions (with a backward pull of one foot and a forward thrust of the other, and the action of the knee and ankle exerting a slight influence over the pedals), "not having complete control over them." To explain my meaning more clearly, your correspondent should use one crank and not two, and then see whether he could start the machine with the crank at the bottom of the throw. By controlling a pedal, I meant that if a machine were going uphill along a rough road with no momentum, each foot would have sufficient control over one pedal or the other to keep the machine going, and in this sense my statement would, I believe, be understood by most readers.

A correspondent, Mr. Edwin Wells, has written and asked me to state my opinion in KNOWLEDGE, "Whether the backward pedalling of the 'Sterling Tricycle' is in conformity with the proper motion of the muscles of the leg?"

This seems to me an important question. If my correspondent means, does the motion of the leg in pedalling the "Sterling" resemble the action of the leg in walking as much as pedalling an ordinary forward-pedalling machine, I should answer at once, certainly not; but the leg has more power over the crank in the backward action than in the forward, and has strong control over the crank through a greater portion of a revolution, and, although other muscles than those used in walking or in driving ordinary machines are brought into play, yet I can answer for it that the motion is not more tiring: from my own experience I should say less so.

JOHN BROWNING.

THE WEATHER FORECASTS.

[765]—I may be wrong in my ideas of fairness, but I am decidedly of opinion that when an individual desires to show the uselessness of the weather forecasts he should certainly not attempt to do so by means of "mental observations taken at various times during different times of the year" (letter 749, p. 153). Neither do I think readers will be impressed with the fairness of a system which compares the forecasts and the weather, and takes note of every time the two disagree, but omits to mention when they agree (*vide* Sir E. Beckett's letter, where he says "When H omits the wind it agreed with the prediction").

[Well, but surely this is indicating when they agree.—R. P.]

After reading the letter on p. 53, I determined during the forthcoming month to institute a rigid comparison between the actual state of the weather and the Meteorological Office's forecasts, and the plan I adopted was the following:—I carefully noted the direction and force of the wind (1 to 12) at 9 a.m., 12, 3, and 6 p.m., and made rough notes at intervals of about two or three hours of the state of the weather. In the evening I brought all my notes before me, and from them compiled an accurate record of the wind and weather of that day. This I entered in my day-book, and then (and *in no case* before then) consulted the forecast and entered it below the history. At the end of the month I summarised the comparisons, and obtained the following results:—On fourteen days the wind agreed both in force *and* direction with the forecast. On nine it agreed with one *or* the other, and on one day only the forecast was entirely wrong. The weather forecast was quite correct on thirteen days, partly correct on eight, and altogether wrong on three. This is the result I have obtained, and it is one, I think, of which the Meteorological Office have no occasion to be ashamed.

With regard to the weather warnings my experience tallies with that of Mr. Mattieu Williams, *i.e.*, that the change comes later than was expected. This was well exemplified on the 19th and 20th. The forecast for the 19th ran: "Light N.W. breezes, and fine, cold weather; wind subsequently backing, and weather becoming cloudy and unsettled." During the whole of the day, however, the weather was settled and the wind constant from the N.W., but on the 20th it backed to S.S.W., and we had a storm of rain and wind.

If this letter serves no other useful end, I shall be content if it draws from Mr. Mattieu Williams the explanation he promised (page 72) if his prophecy proved correct, which it has.

J. W. STANIFORTH.

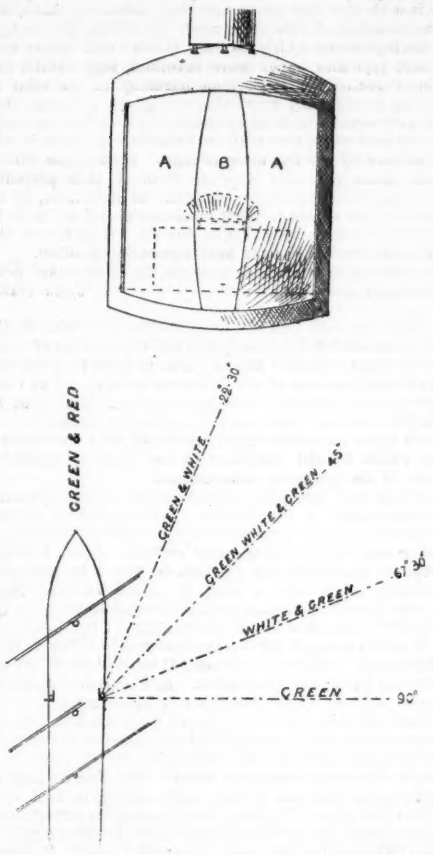
RATIONAL DRESS.

[766]—During my absence from home, the committee of the Rational Dress Society has, I am informed by the Viscountess Harberton, appointed a paid secretary in my stead. Being anxious to continue the work of dress reform with the power which combination gives, I am now forming another society, to be called the Rational Dress Association, composed of both men and women. As I daily receive letters of inquiry as to whether the Exhibition of Rational Dress is to take place, I should be glad to be allowed to state that it most certainly will take place; and that it is only owing to my recent serious illness, and to the many vexatious obstacles which have been thrown in my way, that the necessary arrangements for it have not yet been completed.

Any one wishing for further information may write to me at my town address, 34, Cornwall-road, or my present one; or to my business agent for the Exhibition, Mr. John Flack, 74, Great Queen-street, Lincoln's Inn-Fields. E. M. KING.

STEAMERS' SIDE-LIGHTS.

[767]—Does not the accompanying sketch offer a simple solution to the difficulty of ascertaining another ship's course at night? The separate combination of lights, *i.e.*, green and white, green white and green, or white and green, would respectively show the angle of any other vessel to your own. A system of many lamps, as has been suggested, bears grave objections; simplicity being, in this matter, more than needful. C. H. BROCKELBANK.



[There seems to me no reason why three side-lights, in the form of an equilateral triangle, should be regarded as at all less simple than a single coloured light. They would show a great deal further, indicate by the shape of the triangle the side they were on, the ship's position, her distance, and so forth. Coloured glasses cut off a large part even of a single light's rays.—R. P.]

ALTERATION IN COAST LINE AND SUBMERGED FORESTS.

[768]—A "Southport Resident" (701) imagines that I anticipated in my query (673) that Southport was to become an inland town all at once, and he says there has been no retrocession of the sea for fifty years, which proves that no alteration is taking place. He admits changes are taking place all round Lancashire, and that a fringe of sand varying in breath up to a mile has been formed by this retrocession; but it is on this fringe of sand that my observations were based, and the continual increase of which I anticipated would eventually alter the coast line.

The low water-mark is a remarkable one from the estuary of the Dee round to Morecambe Bay—the water ebbing rapidly in places leaves large areas, which probably will, in the course of time, become dry land.

On the east coast of England, in many places, the water is gaining at the rate of about 3 ft. a century; but I should think the exactly opposite action going on round Southport must be more rapid than this.

Some great changes are taking place in the Isle of Sheppey, on the north of which the water gains so fast by the continual giving way of the cliffs that the old church of Warden has been almost destroyed, and at the present rapid action going on Minster Church, which is such a conspicuous object for so many miles round, and which is only a mile and a-half from the sea, must eventually succumb to the same fate.

I was not aware that there was a submarine forest at the estuary of the Mersey, but such forests are very frequently met with elsewhere, and they tell us, in the same manner that a seam of coal does, of the submergence which has taken place in the case of the latter, probably begun some hundred thousand or more years ago, assuming that these changes are brought about by a gradual process.

An ancient forest was discovered some time ago at a great depth in the dockyard at Sheerness, whilst a well was being sunk. On parts of the Cornish coast, at low tide, stumps of trees may be seen, which are proofs that a submergence is taking place there. I may add that the cliffs at Sheppey are composed of London clay, and are very prolific of fossil remains, some gigantic species of turtles, I believe, having been brought to light by the continual exposure of fresh land. H'SETT.

THE SCHOOL-GIRLS' PROBLEM.

[769]—Here is a symmetrical solution of puzzle 725, p. 106. I shall be curious to know if my method is the same as that of your correspondent:—

DAY

I.	II.	III.	IV.	V.	VI.	VII.
$a_1\ a_3\ a_4$	$a_2\ a_4\ a_5$	$a_3\ a_5\ a_6$	$a_4\ a_6\ a_7$	$a_5\ a_7\ a_1$	$a_6\ a_1\ a_2$	$a_7\ a_2\ a_3$
$b_1\ b_3\ b_4$	$b_3\ b_5\ b_6$	$b_5\ b_7\ b_1$	$b_7\ b_2\ b_3$	$b_2\ b_4\ b_5$	$b_4\ b_6\ b_7$	$b_6\ b_1\ b_2$
$c_1\ c_3\ c_4$	$c_4\ c_6\ c_7$	$c_7\ c_2\ c_3$	$c_3\ c_5\ c_7$	$c_6\ c_1\ c_2$	$c_2\ c_4\ c_5$	$c_5\ c_7\ c_1$
$a_2\ b_2\ c_2$	$a_3\ b_4\ c_5$	$a_4\ b_6\ c_1$	$a_5\ b_1\ c_4$	$a_6\ b_3\ c_7$	$a_7\ b_5\ c_3$	$a_1\ b_7\ c_6$
$a_5\ b_5\ c_5$	$a_6\ b_7\ c_1$	$a_7\ b_2\ c_4$	$a_1\ b_4\ c_7$	$a_2\ b_6\ c_3$	$a_3\ b_1\ c_6$	$a_4\ b_3\ c_2$
$a_6\ b_6\ c_6$	$a_7\ b_1\ c_2$	$a_1\ b_3\ c_5$	$a_2\ b_5\ c_1$	$a_3\ b_7\ c_4$	$a_4\ b_2\ c_7$	$a_5\ b_4\ c_3$
$a_7\ b_7\ c_7$	$a_1\ b_2\ c_3$	$a_2\ b_4\ c_6$	$a_3\ b_6\ c_2$	$a_4\ b_1\ c_5$	$a_5\ b_3\ c_1$	$a_6\ b_5\ c_4$

DAY

VIII.	IX.	X.
$a_1\ b_1\ c_1$	$a_3\ b_3\ c_3$	$a_4\ b_4\ c_4$
$a_2\ b_3\ c_4$	$a_4\ b_5\ c_6$	$a_5\ b_6\ c_7$
$a_3\ b_5\ c_7$	$a_5\ b_7\ c_2$	$a_6\ b_1\ c_3$
$a_4\ b_7\ c_3$	$a_6\ b_2\ c_5$	$a_7\ b_3\ c_6$
$a_5\ b_2\ c_6$	$a_7\ b_4\ c_1$	$a_1\ b_5\ c_2$
$a_6\ b_4\ c_2$	$a_1\ b_6\ c_4$	$a_2\ b_7\ c_5$
$a_7\ b_6\ c_5$	$a_2\ b_1\ c_7$	$a_3\ b_2\ c_1$

The series re-enters to day I. by formula given below—

The twenty-one girls are divided into three groups of 7, and called $a_1\ a_2 \ldots a_7\ b_1\ b_2 \ldots b_7$, &c. The first three rows on days I.—VII. exhaust all combinations of form a a a, b b b, c c c, and the rest are in form a b c.

Assuming order in day I., the following formula gives order for days II.—VII. If a_r occupies a given place on any day the girl in corresponding place on next day will be a_{r+1}, subtracting 7 when the suffix exceeds that number. Similarly, b_{r+2} takes the place of b_r and c_{r+3} of c_r—*e.g.*, on day III. c_5 comes in column 3, row 6; so, in same place on day IV. we have $c_{5+3-7} = c_1$.

Days VIII., IX., X., are formed by reading the first three rows of days I.—VII. downwards, and of the rows thus formed taking 1, 4, 7, &c., for day VIII., 2, 5, &c., for IX., and 3, 6, &c., for X. For these three days the above formula applies to any girl and the one above—*e.g.*, day IX., column 3, row 5, $c_5 = c_{2+3}$.

EAST MARSDEN.

LETTERS RECEIVED.

A. M. D.—A Fellow.—F. R. A. S.—Nemo.—W. Grandy.—Faciebat.—D. W. Staniforth.—Senex.—Solarium.—C. Jacobus.—R. K. Stephens.—A. F.—A Subscriber to KNOWLEDGE.—Lenses.—Boston.—S. E. Clark.—J. A. Robson.—H'sett.—E. B.—B. Blackburn. Difficult to say if eddies would occur in currents so vast.—J. B. W. Mr. Browning will do this.—J. L. Wolff. Rather unsuitable subject.—C. H.—G. Duncan, Sec. Cannot get these numbers myself.—H. H. D. Thanks, but the general character of forecasts now fairly indicated; and space runs short.—Silva.—J. H. C.—Faciebat (&c.). Thanks. How much more useful such discussions of translations than the old-fashioned way, which left no time for them.—F. R. A. S.²—F. A. Pierson.—A. N.—W. J. King.—J. C.

Our Paradox Corner.

FLAT EARTH *V.* GLOBE.

[[Mr. Hampden is angry with me because the second part of his explanation of the flat earth theory did not appear last week. It only reached me at Brighton when the last number of Knowledge was already made up; and by the time the first ensuing post had taken it to Great Queen-street, half the edition would have been printed.

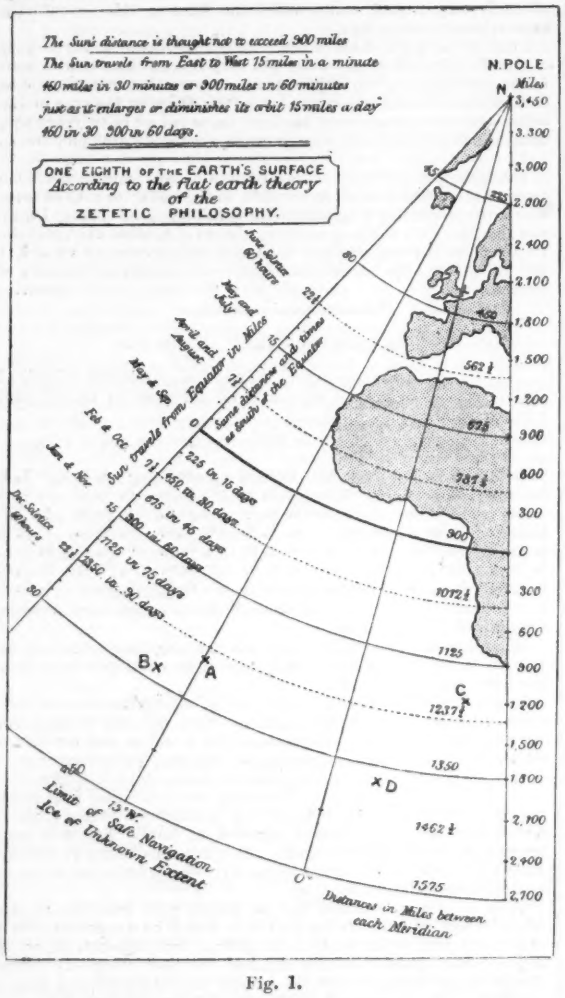


Fig. 1.

The first portion of what was actually sent I have had to omit, for the reason that it was simple denunciation of the accepted views, and I had promised my readers to admit no mere denunciation. in his drawing, and run here from 15° E. to 15° W.; 3°, the addition (for which the preceding change provided) of the details of land and water between those longitudes,—the outlines being taken from a map of the whole earth supplied me by Mr. Hampden; 4°, the addition of the marks A, B, C, D, for purposes of reference, as will be seen below.—R. P.]

"My case is too strong to render me at all disposed to imitate the example of my opponents. But it is with an ill grace that they can avail themselves of a condition which they have so unscrupulously ignored when denouncing my views. However, it is not my nature to be ungenerous, or to exult over a fallen foe. I accept the privilege now accorded me as an *amende* for the unfair treatment I have hitherto been subject to; and I send with this a rough diagram (Fig. 1) of the geometry of the circular plane, and publish it with the full assurance that, sooner or later, it will be the alone standard of reference when describing the configuration of the earth-plane on which we live. It has never before been published since type and paper were invented, and I claim the merit of having detected the marvellous harmony of the solar courses. I do not say it will carry conviction at a glance; though that mind must be very much distorted by prejudice, if it fails to detect in it a degree of perfection that may be looked for in vain in the solar system devised by the ingenuity of man. I am quite willing that it should meet with the severest scrutiny that prejudice and mathematical skill can array against it. If it is false, let it perish and its fallacy be exposed. If it outlives the ordeal, it is to a far higher authority than mine that is due the credit it will claim. I will give some explanations in next succeeding number.

I will endeavour, as far as possible, to confine my articles to about a column and a half. John Hampden.

[Mr. Hampden will understand that I have no wish to dictate to him the course which his description and explanation of the Zetetic philosophy should pursue; nor do I wish to enter into any discussion of the various features of his flat-earth theory. But I know the difficulties which are likely to suggest themselves to those who consider it for the first time; and I venture (in their interests only) to submit a few questions to the teacher of this new (or very old) system, which he will doubtless be very glad to answer in consideration of the ignorance of beginners.

I note first that one great advantage of the new system is that all measurements on the Zetetic chart are made on one scale, unlike our ordinary geographical maps, which vainly essay to picture accurately part of a globe on a flat surface. Now, I note that if we allow the meridians and parallels in Fig. 1 to represent for a moment the sector of the earth in which Victoria, New South Wales, and New Zealand are contained—that is, to range from 135° East to 180°—then A would be the position of Sydney, B of Hobart Town, D of Invercargill (at the extreme south of New Zealand), and C of Auckland. I find the distance AC to be about 2,100 miles, and the distance BD about 2,000 miles. In the steamship *Rotomahana*, of about 1,200 tons, whose average rate of steaming is certainly not more than 300 miles per day, I sailed from Auckland to Sydney in about four days, and a current will not account for the enormous rate thus indicated (more than 500 miles daily), since the journey is made in the same time *both* ways. The Pacific Mail Steamers run constantly between Sydney and Auckland, both ways, in a little over four days. They are noted rather for strength and safety than for speed. Again, from Hobart Town to Invercargill a smaller steamer (700 tons) of the same line carried me in 4½ days, in very unfavourable weather—some 440 miles per day in a steamer whose *best* rate was under 300 miles a day. The journey both ways between Cape Town and Melbourne involves similar difficulties, which Mr. Hampden can, of course, very easily remove for us.

Next,—I think I am right in presenting AA′, BB′, CC′, Fig. 2 (or *aa′*, *bb′*, *cc′*, or lines between these and parallel to them), as side-views of the circular paths of the sun in mid-winter (northern),

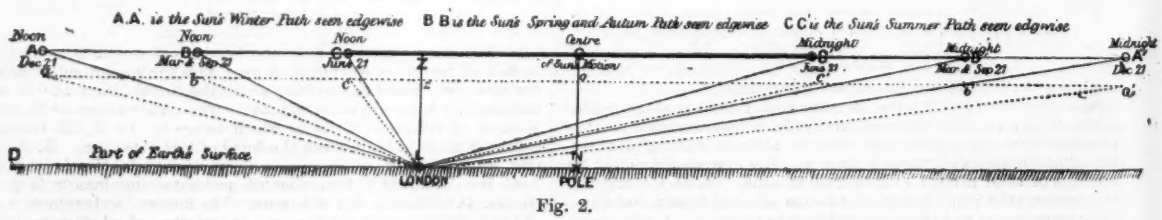

A A′ is the Sun's Winter Path seen edgewise
B B′ is the Sun's Spring and Autumn Path seen edgewise
C C′ is the Sun's Summer Path seen edgewise
Noon
Midnight
Mar & Sep 21
June 21
Dec 21
Centre of Sun's Motion
Part of Earth's Surface
LONDON
N. POLE

Fig. 2.

The illustrative diagram is reduced from Mr. Hampden's drawing, with no other changes but—1°, the addition of a name; 2°, the change of the longitudes represented, which ran from 0° to 45° W. in spring or autumn, and in midsummer, respectively, where D L N represents a side-view of part of the earth's surface. This, in fact, follows obviously from what is shown in Fig. 1. Now the following

points—very trifling, of course, but so much the easier for Mr. Hampden to deal with—seem to require explanation :—

1. L C is much less than half L A, so that the midday sun in December should have an apparent diameter much less than half that of the midday sun in June, and a disc much less than a quarter as large in appearance.

2. I cannot get the angles of elevation right. ∠ A L B should be equal to ∠ B L C; but so long as A B is equal to B C, these angles differ *much* from each other.

3. It looks as though the *midnight* sun in summer should have about the same elevation as the *midday* sun in winter (∠ C′ L N = ∠ A L D).

4. It really looks as though, even in winter, the sun ought never to set—LA′ is considerably inclined to LN.

5. In fact, in my dulness, I cannot see how the sun, always some 900 miles above the earth, the whole diameter of whose accessible surface is only about 6,000 miles, can *ever* set *anywhere*.

6. Still less can I understand—twenty years ago De Morgan showed similar dulness of apprehension—how the sun can go down, as I have seen it go down, square to the horizon in equatorial regions.

7. Then here is a difficulty which puzzles me much. Regarding N D, Fig. 2, for a moment, as the longitude line from the Pole to New Zealand, D would represent about the position of Christchurch, N.Z. A, the place of the midday sun Dec. 21, lies certainly north for the whole of New Zealand, and so does the whole circular path AA′, and so forth. Now, while I over and over again saw the sun, at early morning and late evening in November, December, and January, considerably to the south of the east and west points respectively, I particularly observed this in a long drive I had to take from Oomaru to Timaru on the eastern coast of New Zealand (southern island), one Sunday in December, 1880. I had to start by sunrise, and after reaching Timaru, and having a late dinner, I walked out to watch one of the finest sunsets I have ever seen. I can vouch for it that the sun rose far to the south of east, not reaching due east till long after six, and was due west long before six, setting far to the south of west. Now, it really looks (see Fig. 2) as though, seen from D, the whole course of the sun in December ought to lie on the northern half of the sky. I know it was *not*; but then it is clear, not only from Fig. 2 but from Fig. 1, and from the charts of the whole flat earth which Mr. Hampden has been good enough to send me, that it *ought* to have been.

8. Lastly, I noticed that the daily course of the sun was precisely the same on the northern sky, as seen from places in Australasia, as it was on the southern sky seen from places in America at the same distances north of the equator, at the corresponding seasons (I was in Australasia from May, 1880, to January, 1881, and in America from October to May), *i.e.*, from places far *outside* the circular daily paths assigned to the sun by Mr. Hampden the *shape* of the sun's course on the sky was precisely the same as from places far *inside* those paths. This is difficult to understand; though, doubtless, Mr. Hampden will find it easy to explain.

If he would devote his next explanations to these points, he would please and interest many. Moreover, there can be no doubt that a satisfactory explanation of these difficulties would secure the Zetetic school a great number of adherents. In fact, though I know of many other difficulties, I will enroll myself as a disciple of the new philosophy so soon as the above slight difficulties are removed—not sooner, however. I may add my belief that the new philosophy will be widely accepted when the Newtonian system is rejected—but I think *not before*.—R. P.]

Our Whist Column.

By "Five of Clubs."

PLAYING TRUMPS.

WE come now to cases where you have great strength in trumps. This may consist either in length only, as when you have five or six trumps, no honours; or in combined length and strength, as when you have four trumps, two honours; or in both, as when you have five trumps, or more, two honours.

When you have five trumps, says the book rule, it is always right to lead them; yet experience at once suggests an exception to this rule—for when you want only the odd trick to save or win the game, you do not lead trumps from five. The rule should rather be that it is almost always well to lead trumps. With the original lead, perhaps the only exception is the one just mentioned. But when the preceding play shows that your partner has no good suit, while your own hand contains none outside trumps, leading trumps from five would be bad play, and, as such cases are common, the exception is rather an important one to notice. Suppose, for instance, your hand is weak outside trumps, of which you hold five, and that your opponent on the right leads King of a plain suit, taking the trick; and then a small one, which his partner takes with the Ace; and that then the Queen of another suit is led out, on which your partner puts the Ace and third player a small one. You know now that your opponent on the right has the King card and probably command of his own suit and the King card of his partner's, who holds second and third best. If now your partner leads a small card of the remaining plain suit and you take the trick with the Queen, it would be unwise to lead a trump from five small ones, for your opponents on either side have one suit certainly, and another probably, established, while either the King or the Ace of your partner's suit is on your right. The best use you can make of your trumps is to keep them to ruff your opponents' suits or your partner's (when player to your right puts in his best card in that suit), according to the way your plain suits are distributed. And so in a number of cases where you learn from the play that the probabilities are *not*—as when you lead originally from five trumps and a weak hand—in favour of your partner having at least one strong suit.

But when you are original leader holding five trumps, not more than one honour, and all your plain suits weak, you have good reason for expecting that your partner has one good suit which by means of your trumps you can help him to establish and bring in. Further, the chances are two to one that opening any other suit will be playing the adversaries' game, as you have no means of guessing which is your partner's suit. So that alike for offensive as for defensive considerations, your proper lead is your penultimate trump. (Always excepting the case where you want the odd trick either to save or win the game.)

With a good hand and five trumps you need never hesitate to lead trumps, unless you want the odd trick only—in which case you should always play the surer game of aiming to obtain the odd trick surely; for what good will three or four tricks made from a long suit do you, in such a case, to compensate the risk of failing to get the odd trick?

With a good plain suit, the short suits well protected, and four trumps (two honours), the original lead being with you, you may safely lead trumps, except when playing for the odd trick only. At love, with such a lead, you take the best chance of making game, if your partner has an honour. But this forward play should be regarded as tentative only, and to be dropped at once if your partner shows great weakness in trumps; for then there is reason to fear that one or other of the adversaries may have superior strength to you in trumps.

When you have such a hand, but not the original lead, the question of leading trumps or not will depend on what you infer from the tricks already played.

Strength in trumps sufficient to justify leading them is not sufficient to justify signalling for trumps. When you lead trumps, you nearly always suggest to your partner that it will be well for him to follow your lead; but when you signal, you practically direct him to do so. A really commanding hand is required to justify such a course. Clay indicated, as his own rule, never to signal with fewer than four trumps two honours, or five trumps one honour; but he added that he by no means intended to imply that with such trumps you should always signal. As a matter of fact, you should have good cards in plain suits to justify a signal from the minimum trump hands indicated by Clay.

It is an *almost* constant rule to return your partner's trumps when he has led from strength; but it should be a constant rule to obey the signal, when made by a partner who understands whist. Not to return trumps is only justified—in most cases—by sudden illness, or by having no trumps—one an invalid reason, the other a valid one. Not to respond to the signal is justified only by one of three reasons—having no trumps, sudden illness, or want of confidence in your partner. So if a player, having noticed the signal, and not being ill, fails to lead trumps, he tells his partner, in whist language, that he "disables his judgment."

(To be continued.)

It has been urged against the theoretical importance of the agency of insects in fertilising flowers, that the insects relied upon are rare upon mountain-heights, where the flowers that should be fertilised by them are still abundant. The observations of M. Ch. Musset, of Grenoble, France, which range up to 10,000 feet in height, tend greatly to break the force of this objection. He finds that all the orders of insects are represented to the height of 7,400 feet, and that the number of nectar-seeking insects is proportionate to the number of flowers. The hours of wakefulness and of sleep of the nyctitropic flowers—the number of which is greater than is supposed—and those of the insects are synchronous. The apparent number of nectar-seeking insects, also, is related to the number of their favourite flowers.

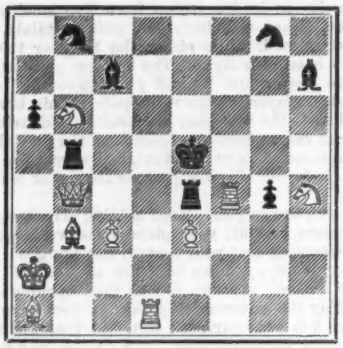
Our Chess Column.

By Mephisto.

PROBLEM No. 81.

By George W. Mitchell.

Black.



White.

White to play and mate in two moves.

OXFORD *v.* CAMBRIDGE.

On Saturday, the 17th inst., the Universities played their annual chess match at the St. George's Chess Club. Both teams fought well, the result being a tie, with a score of five and a half each, *viz.*, four games won and three drawn.

The following well-contested game was played by the head man of each team :

(Board I.)—Scotch Gambit.

White. F. Morley (Kng's), Cantab.	Black. C. D. Locock (Univ.), Oxon.	White. F. Morley (Kng's), Cantab.	Black. C. D. Locock (Univ.), Oxon.
1. P to K4	P to K4	15. Q to Kt3	QR to Qsq
2. Kt to KB3	Kt to QB3	16. P to KB4	Q takes Q
3. P to Q4	P takes P	17. P takes Q	P to KB4
4. Kt takes P	B to B4	18. QR to Qsq	P takes P
5. B to K3	Q to B3	19. Kt takes P	KR to Ksq
6. P to QB3	KKt to K2	20. Kt takes QP	R takes Kt
7. B to QKt5	P to Q3	21. R takes R	R takes B
8. Castles	Castles	22. K to B2	R to K2
9. Kt takes Kt	P takes Kt	23. R to Q5	K to B2
10. B takes B	P takes KB	24. R takes P	R to Q2
11. B to Q4	Q to Kt3	25. R to Ksq	R to Q7 (ch)
12. Q to B3	B to Kt2	26. R to K2	R takes R (ch)
13. Kt to Q2	P to QB4	27. K takes R	
14. B to K3	Kt to B3	Given up as a draw.	

We gladly accepted a proffered invitation, and visited the St. George's Chess Club, the temple of British Chess, where the two rival University teams met, and engaged in an earnest mental contest. Play was conducted with great caution on both sides, and the pace of play was therefore rather slow in some instances. A solemn quietness reigned in the rooms, which are not large. This stillness of matter always causes within us—by a natural reflex action—activity of mind. We were brooding over different subjects, when suddenly the following ominous words of the poet Poe stood before our mind's eye : "The best chess-player in Christendom (?) may be little more than the best player of chess." This opinion, born, perhaps, of a morbid imagination, and nothing else, seemed to us in opposition to all observed facts. We, who know most of the noted players in England, can testify that our strongest amateur chess-players are positively more than merely strong chess-players—they are distinguished in their profession and men of great learning. Broadly speaking, we may state that good chess-players are to be found mostly amongst the higher professions requiring great mental abilities, such as men of great learning and letters, accountants, and clergymen. It occurred to us to put our opinion on this subject to a further practical test, for which the present was a most favourable opportunity. Accordingly, we interviewed one of the Cambridge men, and the following conversation ensued :—

"Do the young men that play chess well make good students at your University ?"

"They do almost without exception; they are mostly hard workers. Students who think more about billiards and horses than of their studies have no aptitude for chess."

"Have any of the strongest chess-players in your team distinguished themselves in their studies ?"

"They have indeed, nearly all of them; we have had many Wranglers in our chess club; of those present, that player at the next table is expected to be third or fourth Wrangler, and his neighbour will not be far behind."

"Are there any athletes amongst your players ?"

"No, not many; they cannot spare the time; but the player I have mentioned to you before, sitting at the next table, rows stroke in his college boat.

"That little man over there with the towering forehead, is he a strong player ?"

"He is an M.A., and considered our strongest player!"

We were highly pleased with the result of our inquiry, and as facts are far stronger than fiction, we were well satisfied that the poet's derogatory opinion of chess and chess-players was fallacious.

Our good opinion of the players was further strengthened on hearing of an achievement highly creditable to young Englishmen. "At the banquet which followed the match that evening, they one and all had a very hearty dinner."

SOLUTIONS.

Problem No. 78, by John Simpson, p. 154.

1. R to Q5 — K takes R, or K to B6 (*b*)
2. Kt to QB3 (ch) — K to B3 (*a*) — 2. R to B5 (ch) K to K5
3. B to Kt3 mate — 3. Kt to Q6 mate

(*a*) If 2. K takes P — Or 2. K to Kt5

3. B to R3 mate — 3. Kt to K3 mate

Or if 2. K to Q5 — (*b*) If 1. B to R4

3. B to B6 mate — 2. B to Kt2 (ch) B to B6

3. R to K5 mate

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Clarence.—Problem received with thanks.

W. T. Pierce.—Thanks for game. Your contributions will always be very welcome.

A. J. Maas.—Sorry your amended position came too late, as you may see by last week's number; we did not consider the duals a sufficient reason for withholding from publication.

Leonard P. Rees. — 10. Castles is a perfect answer to 10. KKt to Kt5 in the Guioco Piano. By investigating this attack, we did not at all mean to imply that it was absolutely or incontestably correct. This you may infer from our introductory remark to this variation, Vol. I., p. 442:—"A. Players of an attacking style might play 10. KKt to Kt5."

Berrow, R. J. P., G. W. Thompson, Delta, T. T. Dorrington, and others.—You have not given the most difficult variation in the author's solution of Problem 79, arising from the defence of 1. B to R4; the others are pretty obvious and commonplace. We shall withold solution to enable you to complete your answers.

Correct solutions received. — Problem 78. R. J. P., T. T. Dorrington. No. 80. W. Clarence, T. T. Dorrington, G. E. Thompson.

A. K. McAdam.—M. T. Hooton; solutions incorrect.

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